

# A NEW SPECIES OF *COTTREAUASTER* (ASTEROIDEA: ECHINODERMATA) FROM THE MIDDLE JURASSIC OF NEW ZEALAND

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*Abstract.* A new asteroid, *Cottreauaster opuatiaensis* (Goniasteridae), is described from a partial specimen preserved in a middle to outer-shelf deposit of the Wilson Sandstone (Late Teraikan Stage; Bajocian), Ponganui, Port Waikato, New Zealand. It is a diminutive sea star, with the genus previously known only from the Northern Hemisphere. The record greatly extends the known distribution of the genus, indicating a Tethyan link in the Middle Jurassic, when New Zealand's palaeogeographic location was in high latitudes off the eastern coast of Gondwana. It is the second asteroid to be described from Port Waikato, and from the Jurassic of New Zealand.

KEYWORDS: Asteroidea; Valvatida; Goniasteracea; Goniasteridae; *Cottreauaster*; new species; Middle Jurassic; Bajocian; Teraikan; Wilson Sandstone; Port Waikato.

## INTRODUCTION

A single near-complete fossil sea star was collected by the author from the Middle Jurassic Wilson Sandstone (Kear 1966), during a field trip to Ponganui, Port Waikato, in March 1998. The articulated specimen was collected *in situ* 2 m above the base of Opuatia Cliff, which is near the junction of a north-western tributary with Opuatia Stream (Fig. 1). The calcareous Wilson Sandstone is composed of mainly fine sandstone intercalated with lenses of coarse tuffaceous sandstone and interbedded concretionary layers of grey-brown siltstone. The Wilson Sandstone is of variable thickness, ranging up to 480 m at Te Akau, thinning northwards to 135 m in the Te Maire area, and reducing to 15 m at its northern extremity at Klondyke Road. The formation is distinguished in the Klondyke Road area by the incoming of the first sandstone above Putau Sandstone (Kear 1966). The fossil locality is interpreted as being a mid-shelf to slope (100-400 m deep) marine deposit that crops out along an inland exposure immediately south of Klondyke Road, Port Waikato (Fig. 1).

## SYSTEMATICS

Taxonomy follows that of Spencer & Wright (1966) and Blake (1987).

PHYLUM: ECHINODERMATA Brugnière, 1791

SUBPHYLUM: ASTEROZOA Zittel, 1895

CLASS: STELLEROIDEA Lamarck, 1816

SUBCLASS: ASTEROIDEA de Blainville, 1830

ORDER: ALVATIDA Perrier, 1884

SUPERFAMILY: GONIASTERACEA Blake, 1987

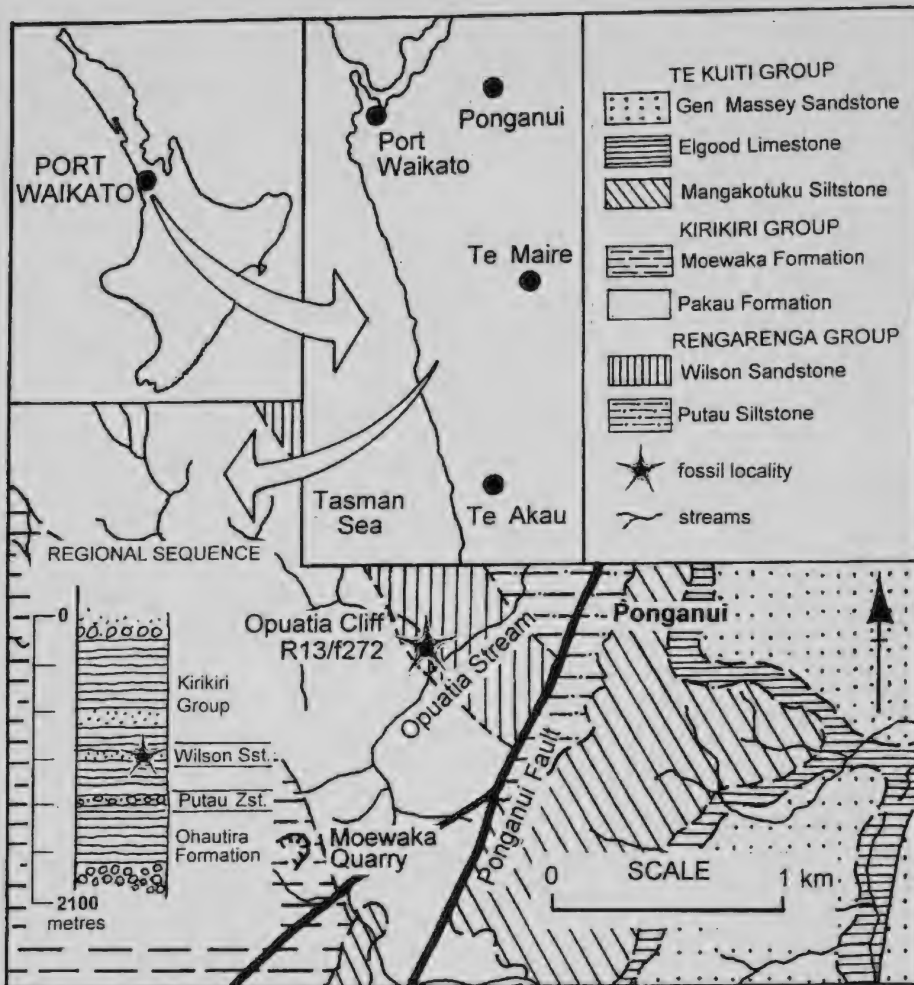


Fig. 1. Geological map showing the type locality (R13/f272) of *Cottreauster opuatiaensis* at Opuatia Cliff, Pongauui, Port Waikato.

**FAMILY:** GONIASTERIDAE Forbes, 1841

*Diagnosis.* Pentagonal to narrowly stellate, generally with large disc; marginals well-differentiated, opposite, normally without specialised interradial marginals; plates on both actinal and abactinal surfaces in close contact; aboral plates flat, tumid, tabulate or paxilliform, with or without spines or granules; pedicellariae most commonly alveolate or valvate (Spencer & Wright 1966).

**SUBFAMILY:** GONIASTERINAE Forbes, 1841

*Diagnosis.* Pentagonal to stellate, often long-armed; genera with few, large marginals, normally with sunken edge; raised smooth or distinctly granulate central area; aboral plates may be flat, smooth, granulate or papillate, or raised round tubercles; specialisation of distal supramarginals may represent >7 marginals fused into enlarged ultimate supramarginal (Spencer & Wright 1966).

GENUS: *Cottreauaster* Wright, 1951

Type species. *Spenceraster lamarei* Cottreau, 1929 (O.D).

Age and distribution. Middle Jurassic (Bathonian), Orne, France.

*Diagnosis.* "Disc small, arms long, narrow, straight-sided, flexible; marginals small, tumid with fine granules; supramarginals with tubercles or spines, aboral plates irregular" (Spencer & Wright 1966: U61).

#### REMARKS

*Cottreauaster* was erected to replace the junior homonym preoccupied by *Spenceraster* Lambert, 1913. Until now *Cottreauaster* has been a monotypic genus confined to the Middle Jurassic (Bathonian) of Europe and found only at one locality in northern France (Cottreau 1929; Spencer & Wright 1966). The New Zealand Middle Jurassic sea star from Port Waikato is most similar to *Comptonia* Gray, 1840 (Aptian—Late Albian), *Noviaster* Vallette, 1929 (Bathonian), and *Cottreauaster* Wright, 1951 (Bathonian). Like the New Zealand fossil sea star, *Comptonia* has arms that are long and slender, with slightly curved interradial arcs. However, the New Zealand specimen, unlike *Comptonia*, does not have square marginals in wide interrays, nor does it have fine, close spine pits on them. *Noviaster*, like the New Zealand specimen also has long, straight-sided arms that are moderately wide at the base, has rounded interradial arcs, and prominent carinals in three rows (reduced to one distally). The New Zealand sea star differs from *Noviaster* by not having marginals with large tubercles on faces between adjoining ossicles, and fine, hexagonal pits on the surface. Additionally, marginals in *Noviaster* are unlike those of the New Zealand specimen in that they are distinctly skewed, tumid, and oriented longitudinally at right-angles to the mid-line of the arm. The New Zealand fossil sea star is placed in the genus *Cottreauaster* because it has a small disc; arms that appear long and straight-sided; marginals that are small and tumid, with fine granules; and aboral paxillae that are irregular in outline.

#### *Cottreauaster opuatiaensis* n. sp. (Figs 3, 5, 6)

#### MATERIAL

Holotype. An external cast of the aboral side with the disc having one marginal and oral ossicle preserved. The distal portions of the arms are missing, and much of the animal, including elements of the skeleton, have been replaced by iron oxide. The specimen is deposited in the type collections of the Marine Department of the Auckland War Memorial Museum (AK73176).

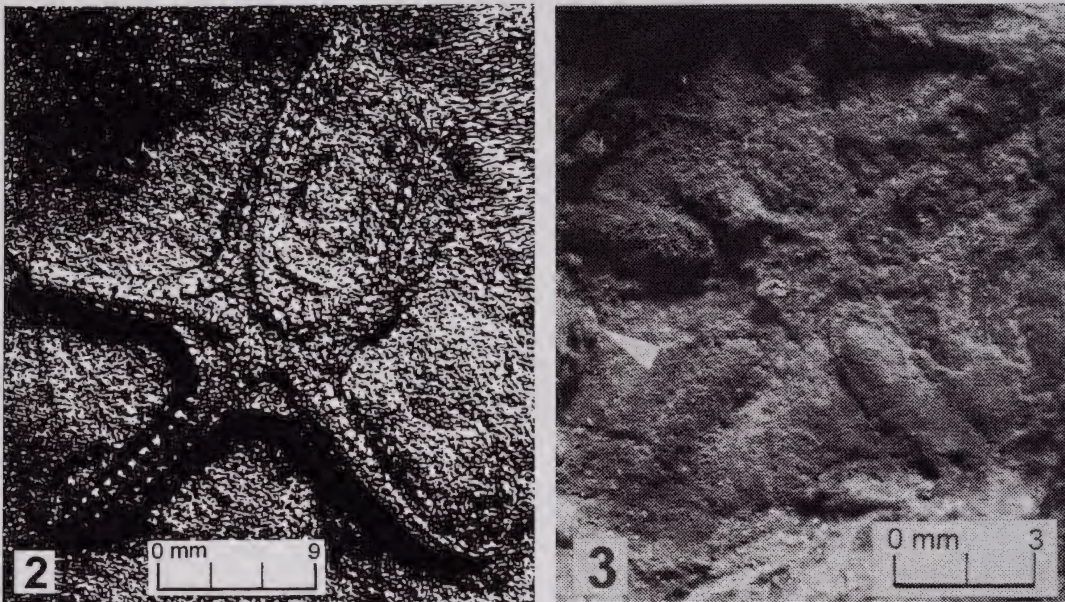
#### TYPE LOCALITY

New Zealand Geological Society Fossil Record File number R13/f272; grid reference R13/722270 (1979, NZMS 260, 1:50 000 map); 2 m above base of Opuatia Cliff, Pongonui, Port Waikato, South Auckland.

*Diagnosis.* Disc pentagonal with minute, regularly arranged paxillae on abactinal surface; marginals quadrangular, small, rounded, covered in fine granules; carinals arched in three rows along mid-line terminating in ossicle assemblage aboral ray surface.

#### DESCRIPTION OF HOLOTYPE

Body flattened, stellate; disc small, pentagonal; arms five, long, narrow, straight-sided, distinct from widely curved interradial arcs; marginals opposite, small, prominent, rounded quadrangular, uniform, tumid with fine granules; supramarginals covered in fine granules; carinals arched,



Figs 2-3. Abactinal views of *Cottreauaster* showing shape, paxillae and supramarginal ossicles and impressions. 2. Holotype of the type species, *C. lamarei*. 3. Holotype of *C. opuatiaensis* n. sp. (quadrangular supramarginal ossicle arrowed). (Fig. 2 from Cottreau 1929.)

prominent, three parallel rows along midline of aboral surface of ray, terminating proximally in large, round, inflated ossicle-assemblage covered in thin, granulose, organic membrane; relatively large, even interradials with irregular, minute, rounded abactinal paxillae, regularly arranged in interlocking pattern, densely packed in rows as series of chevrons meeting along arm midline; arrangement of rows of mid-arm paxillae regular; median paxillae slightly enlarged; orientation of rows of paxillae to arm midline  $36^\circ$ ; intermarginal furrow development wide, deep; actinal surface with single oral preserved, otherwise unknown except for deep, large, circular oral cavity at disc centre; oral ossicle elongate oval with middle groove. Note: Paxillae are minute and do not show well in Fig. 3.

*Measurements.* Arm width between midpoints of interbrachial arcs 3.9 mm; radius (length of ray from disc centre to arm tip) 16.3 mm; arm length (estimated distance from the intersection of the line between adjacent interbrachial midpoints with the midline of the arm to the arm tip) 11.7 mm; diameter of largest paxillae 10  $\mu\text{m}$ ; disc diameter 6.5 mm; ratio arm width to arm length = 0.33:1.

#### AGE

The presence of Bajocian ammonites (Westermann *et al.* 2000) in the same sediments as the specimen of *C. opuatiaensis* confirms a Late Temaikan (Bajocian) age.

#### ETYMOLOGY

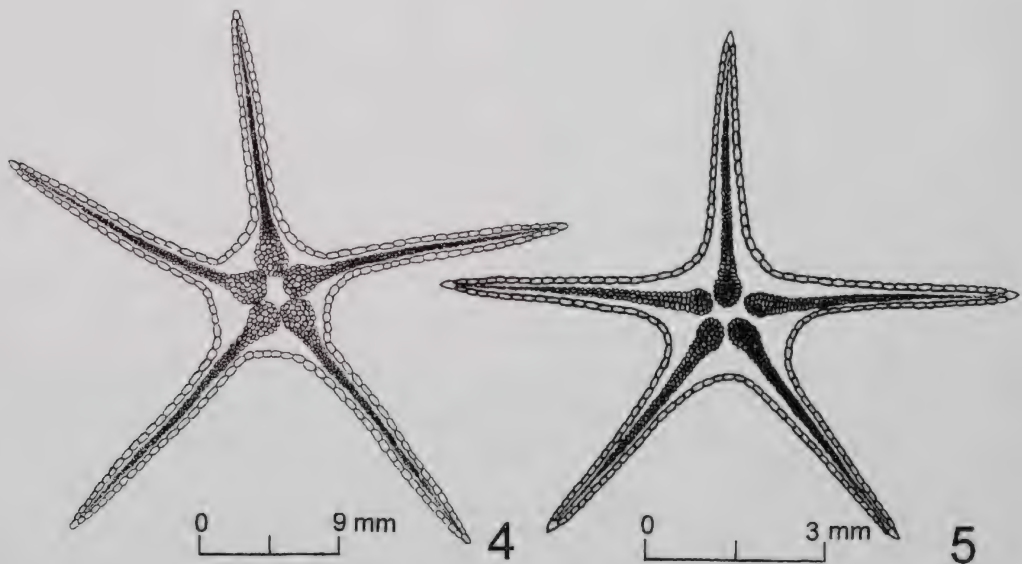
For the type locality, Opuatia Cliff, Ponganui, Port Waikato.

## REMARKS

In valvatidans such as *Cottreuaster*, marginals, where differentiated, provide the guide to recognition (Blake 1987). Marginals originate as a typically double series lateral and actinal to the terminal and they are differentiated by size, alignment, or position (Blake 1987). The single marginal ossicle preserved in *Cottreuaster opuatiaensis* is important for these reasons, as is the overall body form. "Based on overall body form, representatives of certain sea star families can be distinguished at a glance ... These body shapes are considered to represent unified character complexes evolving as integrated wholes, and they are therefore treated as single characters" (Blake 1987: 485).

Allowing for incomplete preservation and consequent difficulty in taxonomic assessment, *Cottreuaster opuatiaensis*, although morphologically similar to *Comptonia comptoni* (Forbes, 1848) (England—Aptian / Late Albian), lacks the small, square marginals on the arms and the short, wide marginals in interrays of that genus. *C. opuatiaensis* has smooth, fine granules on marginal ossicles instead of the fine, close spine pits of *Comptonia comptoni*. *Noviaster lissajousi* Valette, 1929 (England, France—Bathonian), is also similar morphologically to *C. opuatiaensis* but possesses distinctly skewed marginals and three rows of carinals terminating in a large proximal tumid oval ossicle, which *C. opuatiaensis* does not.

*C. opuatiaensis* is morphologically most similar to the type species *C. lamarei* (Figs 2, 4), but differs in several respects. The disc diameter of *C. opuatiaensis* is about half that of *C. lamarei* at 12 mm. The arm length of *C. lamarei* (15 mm), is slightly larger although arm width is similar in both species (4 mm in *C. lamarei*). The marginals of *C. opuatiaensis* are proportionally similar to those of *C. lamarei*, but the interradial area is slightly larger (though this may be due to compaction). The smaller disc, slightly larger interradial area, shorter arm length, smaller, rounded quadrangular marginals with granules, irregular paxillae regularly arranged in chevrons at interradials, and three rows of arched carinals terminating proximally in an oval assemblage



Figs 4-5. Comparison of reconstructed *Cottreuaster lamarei* (4) and *C. opuatiaensis* (5) showing differences in disc outline, arm length, and arm mid-line carinals. (Fig. 4 after Spencer & Wright 1966.)

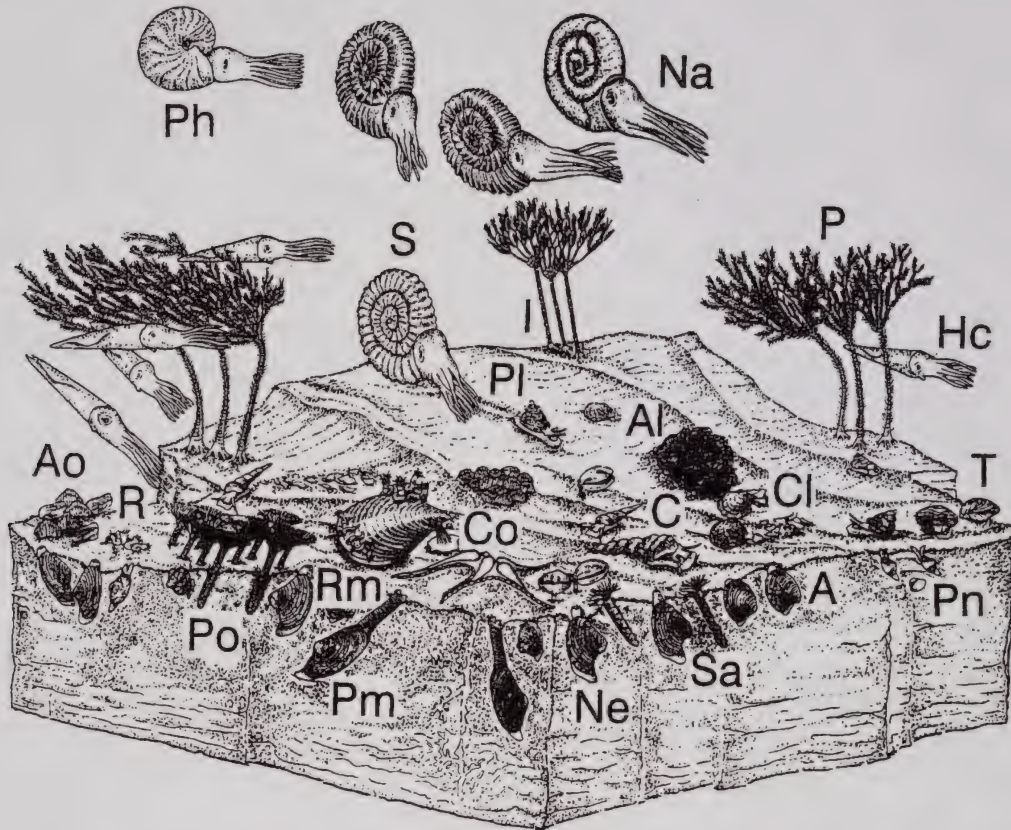


Fig. 6. Schematic drawing of the assumed mid-shelf to slope biocoenosis (100-400 m) at Opuatia Cliff, of which *Cottreuwaster opuatiaensis* may have been a member. No scale implied. A = *Astarte* sp. (Bivalvia); Al = *Aucklandrhynchia lavis* (Brachiopoda); Ao = *A. opuatiaensis* (Brachiopoda); C = "*Cerithinella*" sp. (Gastropoda); Cl = *Camptonectes* cf. *laminatus* (Bivalvia); Co = *Cottreuwaster opuatiaensis* (Echinodermata); Hc = *Hibolithes catlinensis* (Cephalopoda); I = Isocrinidae gen. & sp. indet. (Echinodermata); Na = *Nanolytoceros* sp. (Cephalopoda); Ne = *Neocrassina* sp. (Bivalvia); P = Pentacrinidae gen. & sp. indet. (Echinodermata); Pn = *Palaeonucula* sp. (Bivalvia); Ph = Phylloceratidae gen. & sp. indet. (Cephalopoda); Pl = "*Pleurotomaria*" sp. (Gastropoda); Pm = *Pleuromya milliformis* (Bivalvia); Po = Pogonophora sp. (Annelida); R = *Rotularia* sp. (Annelida); Rm = *Retroceramus marwicki* (Bivalvia); S = Sphaeroceratidae genera & spp. (Cephalopoda); Sa = Sabellidae gen. & sp. indet. (Annelida); T = Terebratulid gen. & sp. indet. (Brachiopoda). Associated biota drawn after McKerrow (1978).

of ossicles, differentiate *C. opuatiaensis* from *C. lamarei*. These characters also differentiate *C. opuatiaensis* from other known fossil or Recent goniasterids.

## DISCUSSION

The collection of a second Jurassic sea star a short distance from the type locality of a slightly younger *Odontaster priscus* Fell (Odontasteridae: Heterian Stage / Bathonian), Moewaka Quarry, Pongau, points to exceptional preservational circumstances at both localities at different times.

Both sea stars are of similar depth range but different environments. They are very small, although each is typical in size for its genus. *Cottreauaster opuatiaensis* and *Odontaster priscus*, so far as can be ascertained, readily fit modes of life established for modern sea stars. *C. opuatiaensis* and *O. priscus*, being found on soft substrates among other benthic invertebrates, are thought to have been detrital and carnivorous feeders on benthic protozoans, crustaceans, small molluscs, and polychaetes. It is possible that, because of the small size of *C. opuatiaensis*, the Opuatia Cliff specimen has been introduced either living or postmortem into the fossil locality by an offshore sediment gravity flow, or by failed predation. However, preservation of numerous benthic invertebrates at the Opuatia Cliff locality (Westermann *et al.* 2000) suggests *C. opuatiaensis* may also have fossilised *in situ*. The biocoenoses of both fossil localities includes bivalves, gastropods, scaphopods, polychaetes, ammonites, brachiopods, and crinoids. The high molluscan diversity at the Opuatia Cliff locality (Westerman *et al.* 2000) indicates a water depth of 100-400 m (mid-shelf to slope; J.A. Grant-Mackie pers. comm.) (Fig. 6) east of the Antarctic coast of Gondwana, 60° south, enjoying temperate seas of moderate salinity, constrained by about four months of darkness (Stevens *et al.* 1988).

Though a large proportion of the known fossil Asteroidea are assigned to the Valvatida (Spencer & Wright 1966), knowledge of the phylogeny of genera and species is limited. Goniasteracea of Blake (1987) are known from Early Jurassic to Recent. However, fossil sea stars in New Zealand are rarely found intact (Eagle 1999), and the record of *Cottreauaster* in New Zealand, almost antipodal to northern France, greatly extends the known distribution of the genus. It again fulfills the prediction made by Fell (1952: 146) that “it now begins to look as if we may expect to find other parallels between the Mesozoic echinoderms of Europe and New Zealand despite the present lack of corresponding fossil records from intervening points on the globe”. Speden (1959) provided the first confirmation by describing New Zealand’s only cyrtocrinid, *Phyllocrinus furcillatus* (late Tithonian), previously known only from Europe (also from France). A Jurassic Tethyan link is suggested by the presence of *Phyllocrinus furcillatus* and *Cottreauaster opuatiaensis* in New Zealand. The New Zealand Late Tertiary Stage (Bajocian) *Cottreauaster* record predates the French occurrence (Bathonian) by c. 5 million years.

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